

SEQUENCE LISTING

<110> Berry, Alan  
Burlingame, Richard P.  
Millis, James R.

<120> PROCESS AND MATERIALS FOR PRODUCTION OF GLUCOSAMINE

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<151> 1998-01-14

<150> 60/035,494

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ctc ggt aaa gtc cag atg ctg gca cag gca gcg gaa gaa cat cct ctg 192  
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cat ggc ggc act ggt att gct cac act cgc tgg gcg acc cac ggt gaa 240  
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gtg cat aac ggc atc atc gaa aac cat gaa ccg ctg cgt gaa gag cta 336  
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aaa gcg cgt ggc tat acc ttc gtt tct gaa acc gac acc gaa gtg att 384  
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gcc cat ctg gtg aac tgg gag ctg aaa caa ggc ggg act ctg cgt gag 432  
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ctg ctg tcg aag gtt gag cat att cag atc ctc gcc tgt ggt act tct 912  
 Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
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tat aac tcc ggt atg gtt tcc cgc tac tgg ttt gaa tcg cta gca ggt 960  
 Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
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att ccg tgc gac gtc gaa atc gcc tct gaa ttc cgc tat cgc aaa tct 1008  
 Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
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gcc gtg cgt cgt aac agc ctg atg atc acc ttg tca cag tct ggc gaa 1056  
 Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
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acc gcg gat acc ctg gct ggc ctg cgt ctg tcg aaa gag ctg ggt tac 1104  
 Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
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ctt ggt tca ctg gca atc tgt aac gtt ccg ggt tct tct ctg gtg cgc 1152  
 Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
 370 375 380

gaa tcc gat ctg gcg cta atg acc aac gcg ggt aca gaa atc ggc gtg 1200  
 Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
 385 390 395 400

gca tcc act aaa gca ttc acc act cag tta act gtg ctg ttg atg ctg			1248
Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu			
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gtg gcg aag ctg tct cgc ctg aaa ggt ctg gat gcc tcc att gaa cat			1296
Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His			
420	425	430	
gac atc gtg cat ggt ctg cag gcg ctg ccg agc cgt att gag cag atg			1344
Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met			
435	440	445	
ctg tct cag gac aaa cgc att gaa gcg ctg gca gaa gat ttc tct gac			1392
Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp			
450	455	460	
aaa cat cac gcg ctg ttc ctg ggc cgt ggc gat cag tac cca atc gcg			1440
Lys His His Ala Leu Phe Leu Gly Arg Gly Asp Gln Tyr Pro Ile Ala			
465	470	475	480
ctg gaa ggc gca ttg aag ttg aaa gag atc tct tac att cac gct gaa			1488
Leu Glu Gly Ala Leu Lys Leu Glu Ile Ser Tyr Ile His Ala Glu			
485	490	495	
gcc tac gct gct ggc gaa ctg aaa cac ggt ccg ctg gcg cta att gat			1536
Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp			
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gcc gat atg ccg gtt att gtt gtt gca ccg aac aac gaa ttg ctg gaa			1584
Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu			
515	520	525	
aaa ctg aaa tcc aac att gaa gaa gtt cgc gcg cgt ggc ggt cag ttg			1632
Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu			
530	535	540	
tat gtc ttc gcc gat cag gat gcg ggt ttt gta agt agc gat aac atg			1680
Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met			
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cac atc atc gag atg ccg cat gtg gaa gag gtg att gca ccg atc ttc			1728
His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe			
565	570	575	
tac acc gtt ccg ctg cag ctg gct tac cat gtc gcg ctg atc aaa			1776
Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys			
580	585	590	

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Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
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His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80

Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
85 90 95

Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
100 105 110

Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
115 120 125

Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
130 135 140

Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
145 150 155 160

Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
165 170 175

Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
180 185 190

Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
195 200 205

Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
210 215 220

Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
225 230 235 240

Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
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Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile  
260 265 270

Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
275 280 285

Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
290 295 300

Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
305 310 315 320

Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
325 330 335

Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
340 345 350

Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
355 360 365

Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
370 375 380

Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
385 390 395 400

Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
405 410 415

Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
420 425 430

Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met  
435 440 445

Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp  
450 455 460

Lys His His Ala Leu Phe Leu Gly Arg Gly Asp Gln Tyr Pro Ile Ala  
465 470 475 480

Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
485 490 495

Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
500 505 510

Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu  
515 520 525

Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
530 535 540

Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met  
545 550 555 560

His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe  
565 570 575

Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
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accatgtgtg gaactgttgg cgcgatcgcg caacgtgtat tagcagaaa ctttcttcaa 180

ggtttacgtc gtctggataa ccgcggatata gactctgccg gtctggccgt tggtatgca 240  
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Leu Leu Glu Gly Leu Arg Arg Leu Glu Tyr Arg Gly Tyr Asp Ser Ala  
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ggt ctg gcc gtt gtt gat gca gaa ggt cat atg acc cgc ctg cgt cgc 144  
Gly Leu Ala Val Val Asp Ala Glu Gly His Met Thr Arg Leu Arg Arg  
35 40 45

ctc ggt aaa gtc cag atg ctg gca cag gca gcg gaa gaa cat cct ctg 192  
Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
50 55 60

cat ggc ggc act ggt att gct cac act cgc tgg gcg acc cac ggt gaa 240  
 His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
 65 70 75 80

cct tca gaa gtg aat gcg cat ccg cat gtt tct gaa cac att gtg gtg 288  
 Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
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gtg cat aac ggc atc atc gaa aac cat gaa ccg ctg cgt gaa gag cta 336  
 Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
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 Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
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gcc cat ctg gtg aac tgg gag ctg aaa caa ggc ggg act ctg cgt gag 432  
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gcc gtt ctg cgt gct atc ccg cag ctg cgt ggt gcg tac ggt aca gtg 480  
 Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
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atc atg gac tcc cgt cac ccg gat acc ctg ctg gcg gca cgt tct ggt 528  
 Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
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 Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
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 Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
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 Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
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tat gac gcg ggc gat aaa ggc att tac cgt cac tac atg cag aaa gag 768  
 Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
 245 250 255

atc tac gaa cag ccg aac gcg atc aaa aac acc ctt acc gga cgc acc 816  
 Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Thr  
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agc cac ggt cag gtt gat tta agc gag ctg gga ccg aac gcc gac gaa 864  
 Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
 275 280 285

ctg ctg tcg aag gtt gag cat att cag atc ctc gcc tgt ggt act tct 912  
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 Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
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 Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
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gtg gcg aag ctg tct cgc ctg aaa ggt ctg gat gcc tcc att gaa cat 1296  
 Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
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gac atc gtg cat ggt ctg cag gcg ctg ccg agc cgt att gag cag atg 1344  
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- ctg cct cag gac aaa cgc att gaa gcg ctg gca gaa gat ttc tct gac 1392  
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 565 570 575

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 Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
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ggc acc gac gtt gac cag ccg cgt aac ctg gca aaa tcg gtt acg gtt 1824  
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Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
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His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80

Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
85 90 95

Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
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Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
115 120 125

Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
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Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
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Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
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Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
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Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
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Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
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Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
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Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Thr  
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Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
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Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
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Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
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Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
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Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
355 360 365

Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
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Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
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Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
405 410 415

Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
420 425 430

Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met  
435 440 445

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Lys His His Ala Leu Phe Leu Gly Arg Gly Asp Gln Tyr Pro Ile Ala  
465 470 475 480

Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
485 490 495

- Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
500 505 510

Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu  
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Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
530 535 540

Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met  
545 550 555 560

His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe  
565 570 575

Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
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cgtaacagcc tgatgatcac ctgtcacag tctggcgaaa cccgcggatac cctggctggc 1200  
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- atttttcttc ctgttatgtt ttaatcaaa catcctgcca actccatgtg acaaaccgtc 2040  
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<213> Escherichia coli

<220>  
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ctt ctt gaa ggt tta cgt cgt ctg gaa tac cgc gga tat gac tct gcc 96  
Leu Leu Glu Gly Leu Arg Arg Leu Glu Tyr Arg Gly Tyr Asp Ser Ala  
20 25 30

ggc ctg gcc gtt gtt gat aca gaa ggt cat atg acc cgc ctg cgt cgc 144  
Gly Leu Ala Val Val Asp Thr Glu Gly His Met Thr Arg Leu Arg Arg  
35 40 45

ctc ggt aaa gtc cag atg ctg gca cag gca gcg gaa gaa cat cct ctg 192  
Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
50 55 60

cat ggc ggc act ggt att gct cac act cgc tgg gcg acc cac ggt gaa 240  
His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80

cct tca gaa gtg aat gcg cat ccg cat gtt tct gaa cac att gtg gtg 288  
Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
85 90 95

gtg cat aac ggc atc atc gaa aac cat gaa ccg ctg cgt gaa gag cta 336  
Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
100 105 110

aaa gcg cgt ggc tat acc ttc gtt tct gaa acc gac acc gaa gtg att 384

Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
 115 120 125  
 gcc cat ctg gtg aac tgg gag ctg aaa caa ggc ggg act ctg cgt gag 432  
 Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
 130 135 140  
 gcc gtt ctg cgt gct atc ccg cag ctg cgt ggt gcg tac ggt aca gtc 480  
 Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
 145 150 155 160  
 atc atg gac tcc cgt cac ccg gat acc ctg ctg gcg gca cgt tct ggt 528  
 Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
 165 170 175  
 agt ccg ctg gtg att ggc ctg ggg atg ggc gaa aac ttt atc gct tct 576  
 Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
 180 185 190  
 gac cag ctg gcg ctg ttg ccg gtg acc cgt cgc ttt atc ttc ctt gaa 624  
 Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
 195 200 205  
 gag ggc gat att gcg gaa atc act cgc cgt tcg gta aac atc ttc gat 672  
 Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
 210 215 220  
 aaa act ggc gcg gaa gta aaa cgt cag gat atc gaa tcc aat ctg caa 720  
 Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
 225 230 235 240  
 tat gac gcg ggc gat aaa ggc att tac tgt cac tac atg cag aaa gag 768  
 Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Cys His Tyr Met Gln Lys Glu  
 245 250 255  
 atc tac gaa cag ccg aac gcg atc aaa aac acc ctt acc gga cgc atc 816  
 Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile  
 260 265 270  
 agc cac ggt cag gtt gat tta agc gag ctg gga ccg aac gcc gac gaa 864  
 Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
 275 280 285  
 ctg ctg tcg aag gtt gag cat att cag atc ctc gcc tgt ggt act tct 912  
 Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
 290 295 300  
 tat aac tcc ggt atg gtt tcc cgc tac tgg ttt gaa tcg cta gca ggt 960

Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
 305 310 315 320  
 att ccg tgc gac gtc gaa atc gcc tcc gaa ttc cgc tat cgc aaa tct 1008  
 Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
 325 330 335  
 gcc gtg cgt cgt aac agc ctg atg atc acc ttg tca cag tct ggc gaa 1056  
 Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
 340 345 350  
 acc gcg gat acc ctg gct ggc ctg cgt ctg tcg aaa gag ctg ggt tac 1104  
 Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
 355 360 365  
 ctt ggt tca ctg gca atc tgt aac gtt ccg ggt tct tct ctg gtg cgc 1152  
 Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
 370 375 380  
 gaa tcc gat ctg gcg cta atg acc aac gcg ggt aca gaa atc ggc gtg 1200  
 Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
 385 390 395 400  
 gca tcc act aaa gca ttc acc act cag tta act gtg ctg ttg atg ctg 1248  
 Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
 405 410 415  
 gtg gcg aag ctg tct cgc ctg aaa ggt ctg gat gcc tcc att gaa cat 1296  
 Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
 420 425 430  
 gac atc gtg cat ggt ctg cag gcg ctg ccg agc cgt att gag cag atg 1344  
 Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met  
 435 440 445  
 ctg tct cag gac aaa cgc att gaa gcg ctg gca gaa gat ttc tct gac 1392  
 Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp  
 450 455 460  
 aaa cat cac gcg ctg ttc ctg agc cgt ggc gat cag tac cca atc gcg 1440  
 Lys His His Ala Leu Phe Leu Ser Arg Gly Asp Gln Tyr Pro Ile Ala  
 465 470 475 480  
 ctg gaa ggc gca ttg aag ttg aaa gag atc tct tac att cac gct gaa 1488  
 Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
 485 490 495  
 gcc tac gct gct ggc gaa ctg aaa cac ggt ccg ctg gcg cta att gat 1536

Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
 500 505 510  
 gcc gat atg ccg gtt att gtt gtt gca ccg aac aac gaa ttg ctg gaa 1584  
 Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu  
 515 520 525  
 aaa ctg aaa tcc aac att gaa gaa gtt cgc gcg cgt ggc ggt cag ttg 1632  
 Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
 530 535 540  
 tat gtc ttc gcc gat cag gat gcg ggt ttt gta agt agc gat aac atg 1680  
 Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met  
 545 550 555 560  
 cac atc atc gag atg ccg cat gtg gaa gag gtg att gca ccg atc ttc 1728  
 His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe  
 565 570 575  
 tac acc gtt ccg ctg cag ctg ctg gct tac cat gtc gcg ctg atc aaa 1776  
 Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
 580 585 590  
 ggc acc gac gtt gac cag ccg cgt aac ctg gca aaa tcg gtt acg gtt 1824  
 Gly Thr Asp Val Asp Gln Pro Arg Asn Leu Ala Lys Ser Val Thr Val  
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 Glu  
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<210> 22

<211> 609

<212> PRT

<213> Escherichia coli

<400> 22

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Gly Leu Ala Val Val Asp Thr Glu Gly His Met Thr Arg Leu Arg Arg  
 35 40 45

Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu

50 55 60

His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80

Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
85 90 95

Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
100 105 110

Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
115 120 125

Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
130 135 140

Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
145 150 155 160

Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
165 170 175

Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
180 185 190

Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
195 200 205

Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
210 215 220

Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
225 230 235 240

Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Cys His Tyr Met Gln Lys Glu  
245 250 255

Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile  
260 265 270

Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
275 280 285

Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
290 295 300

Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly

305 310 315 320  
Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
325 330 335  
Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
340 345 350  
Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
355 360 365  
Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
370 375 380  
Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
385 390 395 400  
Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
405 410 415  
Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
420 425 430  
Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met  
435 440 445  
Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp  
450 455 460  
Lys His His Ala Leu Phe Leu Ser Arg Gly Asp Gln Tyr Pro Ile Ala  
465 470 475 480  
Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
485 490 495  
Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
500 505 510  
Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu  
515 520 525  
Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
530 535 540  
Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met  
545 550 555 560  
His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe

565

570

575

Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
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Gly Thr Asp Val Asp Gln Pro Arg Asn Leu Ala Lys Ser Val Thr Val  
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Glu

<210> 23

<211> 2184

<212> DNA

<213> Escherichia coli

<400> 23

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accatgtgtg gaattgttgg cgcgatcgcg caacgtatgt tagcagaaat cttcttgaa 180

ggtttacgtc gtctggaata ccgcggatata gactctgcccgt gtctggccgt tttgtatgca 240

gaaggtcata tgacccgcct gcgtcgccctc ggtaaaatcc agatgtgtgc acaggcagcg 300

gaagaacatc ctctgcatgg cggcactggat attgctcaca ctcgctggc gaccacgg 360

gaaccttcag aagtgaatgc gcatccgcat gttccgaac acattgtgtt ggtgcataac 420

ggcatcatcg aaaaccatga accgctgcgtt gaagagctaa aagcgcgtgg ctataaccc 480

gtttctgaaa ccgacaccga agtgattgcc catctggta actgggagct gaaacaaggc 540

gggactctgc gtgaggccgt tctgcgtgt atcccgacgc tgcgtggcgt gtacggata 600

gtgatcatgg actccgtca cccggataacc ctgctggcgg cacgttctgg tagtccgctg 660

gtgattggcc tggggatggg cgaaaacttt atcgcttctg accagctggc gctgttgcgg 720

gtgacccgtc gctttatctt cttgaagag ggcgatattt cggaaatcac tcgcccgtcg 780

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aatgtttgtt attgactgaa tatcaacgct ctagaggggc tagagcggcc accaccgcgg 2160  
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<210> 24

<211> 1830

<212> DNA

<213> Escherichia coli

<220>  
<221> CDS  
<222> (1)...(1830)

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...  
ctt ctt gaa ggt tta cgt cgt ctg gaa tac cgc gga tat gac tct gcc 96  
Leu Leu Glu Gly Leu Arg Arg Leu Glu Tyr Arg Gly Tyr Asp Ser Ala  
20 25 30  
...  
ggc ctg gcc gtt gtt gat gca gaa ggt cat atg acc cgc ctg cgt cgc 144  
Gly Leu Ala Val Val Asp Ala Glu Gly His Met Thr Arg Leu Arg Arg  
35 40 45  
...  
ctc ggt aaa gtc cag atg ctg gca cag gca gcg gaa gaa cat cct ctg 192  
Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
50 55 60  
...  
cat ggc ggc act ggt att gct cac act cgc tgg gcg acc cac ggt gaa 240  
His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80  
...  
cct tca gaa gtg aat gcg cat ccg cat gtt tcc gaa cac att gtg gtg 288  
Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
85 90 95  
...  
gtg cat aac ggc atc atc gaa aac cat gaa ccg ctg cgt gaa gag cta 336  
Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
100 105 110  
...  
aaa gcg cgt ggc tat acc ttc gtt tct gaa acc gac acc gaa gtg att 384  
Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
115 120 125  
...  
gcc cat ctg gtg aac tgg gag ctg aaa caa ggc ggg act ctg cgt gag 432  
Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
130 135 140  
...  
gcc gtt ctg cgt gct atc ccg cag ctg cgt ggt gcg tac ggt aca gtg 480  
Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
145 150 155 160  
...  
atc atg gac tcc cgt cac ccg gat acc ctg ctg gcg gca cgt tct ggt 528  
Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly

165	170	175	
agt ccg ctg gtg att ggc ctg ggg atg ggc gaa aac ttt atc gct tct			576
Ser Pro Leu Val Ile Gly Leu Gly Met Gly Asn Phe Ile Ala Ser			
180	185	190	
gac cag ctg gcg ctg ttg ccg gtg acc cgt cgc ttt atc ttc ctt gaa			624
Asp Gin Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu			
195	200	205	
gag ggc gat att gcg gaa atc act cgc cgt tcg gta aac atc ttc gat			672
Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp			
210	215	220	
aaa act ggc gcg gaa gta aaa cgt cag gat atc gaa tcc aat ctg caa			720
Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln			
225	230	235	240
tat gac gcg ggc gat aaa ggc att tac cgt cac tac atg cag aaa gag			768
Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu			
245	250	255	
atc tac gaa cag ccg aac gcg atc aaa aac acc ctt acc gga cgc atc			816
Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile			
260	265	270	
agc cac ggt cag gtt gat tta agc gag ctg gga ccg aac gcc gac gaa			864
Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu			
275	280	285	
ctg ctg tcg aag gtt gag cat att cag atc ctc gcc tgt ggt act tct			912
Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser			
290	295	300	
tat aac tcc ggt atg gtt tcc cgc tac tgg ttt gaa tcg cta gca ggt			960
Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly			
305	310	315	320
att ccg tgc gac gtc gaa atc gcc tct gaa ttc cgc tat cgc aaa tct			1008
Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser			
325	330	335	
gcc gtg cgt cgt aac agc ctg atg atc acc ttg tca cag tct ggc gaa			1056
Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu			
340	345	350	
acc gcg gat acc ctg gct ggc ctg cgt tcg aaa gag ctg ggt tac			1104
Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr			

355	360	365	
ctt ggt tca ctg gca atc tgt aac gtt ccg ggt tct tct ctg gtg cgc			1152
Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg			
370	375	380	
gaa tcc gat ctg gcg cta atg acc aac gcg ggt aca gaa atc ggc gtg			1200
Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val			
385	390	395	400
gca tcc act aaa gca ttc acc act cag tta act gtg ctg ttg atg ctg			1248
Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu			
405	410	415	
gtg gcg aag ctg tct cgc ctg aaa ggt ctg gat gcc tcc att gaa cat			1296
Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His			
420	425	430	
gac atc gtg cat ggt ctg cag gcg ctg ccg agc cgt att gag cag atg			1344
Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met			
435	440	445	
ctg tct cag gac aaa cgc att gaa gcg ctg gca gaa gat ttc tct gac			1392
Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp			
450	455	460	
aaa cat cac gcg ccg ttc ctg ggc cgt ggc gat cag tac cca atc gcg			1440
Lys His His Ala Pro Phe Leu Gly Arg Gly Asp Gln Tyr Pro Ile Ala			
465	470	475	480
ctg gaa ggc gca ttg aag ttg aaa gag atc tct tac att cac gct gaa			1488
Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu			
485	490	495	
gcc tac gct ggc gaa ctg aaa cac ggt ccg ctg gcg cta att gat			1536
Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp			
500	505	510	
gcc gat atg ccg gtt att gtt gca ccg aac aac gaa ttg ctg gaa			1584
Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu			
515	520	525	
aaa ctg aaa tcc aac att gaa gaa gtt cgc gcg cgt ggc ggt cag ttg			1632
Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu			
530	535	540	
tat gtc ttc gcc gat cag gat gcg ggt ttt gta agt agc gat aac atg			1680
Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met			

545	550	555	560
cac atc atc gag atg ccg cat gtg gaa gag gtg att gca ccg atc ttc			
His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe			
565	570	575	1728
tac acc gtt ccg ctg cag ctg ctg gct tac cat gtc gcg ctg atc aaa			
Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys			
580	585	590	1776
ggc acc gac gtt gac cag ccg cgt aac ctg gca aaa tcg gtt acg gtt			
Gly Thr Asp Val Asp Gln Pro Arg Asn Leu Ala Lys Ser Val Thr Val			
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gag taa			
Glu			
610			1830
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Leu Leu Glu Gly Leu Arg Arg Leu Glu Tyr Arg Gly Tyr Asp Ser Ala			
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Gly Leu Ala Val Val Asp Ala Glu Gly His Met Thr Arg Leu Arg Arg			
35	40	45	
Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu			
50	55	60	
His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu			
65	70	75	80
Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val			
85 90 95			
Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu			
100	105	110	
Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile			
115	120	125	

Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
130 135 140

Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
145 150 155 160

Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
165 170 175

Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
180 185 190

Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
195 200 205

Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
210 215 220

Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
225 230 235 240

Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
245 250 255

Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile  
260 265 270

Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
275 280 285

Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
290 295 300

Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
305 310 315 320

Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
325 330 335

Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
340 345 350

Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
355 360 365

Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
370 375 380

Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
385 390 395 400

Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
405 410 415

Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
420 425 430

Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met  
435 440 445

Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp  
450 455 460

Lys His His Ala Pro Phe Leu Gly Arg Gly Asp Gln Tyr Pro Ile Ala  
465 470 475 480

Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
485 490 495

Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
500 505 510

Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu  
515 520 525

Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
530 535 540

Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met  
545 550 555 560

His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe  
565 570 575

Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
580 585 590

Gly Thr Asp Val Asp Gln Pro Arg Asn Leu Ala Lys Ser Val Thr Val  
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Glu

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<212> DNA

<213> Escherichia coli

<400> 26

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accatgtgtg gaattgttgg cgcgatcgcg caacgtgtat tagcagaaat cttcttgaa 180  
ggtttacgtc gtctgaaata ccgcggatat gactctgccc gtctggccgt tttgtatgca 240  
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ctt ctt gaa ggt tta cgt cgt ctg gaa tac cgc gga tat gac tct gcc 96  
Leu Leu Glu Gly Leu Arg Arg Leu Glu Tyr Arg Gly Tyr Asp Ser Ala  
20 25 30

ggt ctg gcc gtt gat gca gaa ggt cat atg acc cgc ctg cgt cgc	35	40	45	144
Gly Leu Ala Val Val Asp Ala Glu Gly His Met Thr Arg Leu Arg Arg				
ctc ggt aaa gtc cag atg ctg gca cag gca gcg gaa gaa cat cct ctg	50	55	60	192
Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu				
cat ggc ggc act ggt att gct cac act cgc tgg gcg acc cac ggt gaa	65	70	75	240
His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu				
cct tca gaa gtg aat gcg cat ccg cat gtt tct gaa cac att gtg gtg	85	90	95	288
Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val				
gtg cat aac ggc atc atc gaa aac cat gaa ccg ctg cgt gaa gag cta	100	105	110	336
Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu				
aaa gcg cgt ggc tat acc ttc gtt tct gaa acc gac acc gaa gtg att	115	120	125	384
Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile				
gcc cat ctg gtg aac tgg gag ctg aaa caa ggc ggg act ctg cgt gag	130	135	140	432
Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu				
atc atg gac tcc cgt cac ccg gat acc ctg ctg gcg gca cgt tct ggt	145	150	155	480
Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly				
165	170	175		528
agt ccg ctg gtg att ggc ctg ggg atg ggc gaa aac ttt atc gct tct	180	185	190	576
Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser				
gac cag ctg gcg ctg ttg ccg gtg acc cgt cgc ttt atc ttc ctt gaa	195	200	205	624
Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu				
gag ggc gat att gcg gaa atc act cgc cgt tcg gta aac atc ttc gat	210	215	220	672
Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp				

aaa act ggc gcg gaa gta aaa cgt cag gat atc gaa tcc aat ctg caa 720  
 Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
 225 230 235 240

tat gac gcg ggc gat aaa ggc att tac cgt cac tac atg cag aaa gag 768  
 Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
 245 250 255

atc tac gaa cag ccg aac gcg atc aaa aac acc ctt acc gga\_cgc atc 816  
 Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile  
 260 265 270

agc cac ggt cag gtt gat tta agc gag ctg gga ccg aac gcc gac gaa 864  
 Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
 275 280 285

ctg ctg tcg aag gtt gag cat att cag atc ctc gcc tgt ggt act tct 912  
 Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
 290 295 300

tat aac tcc ggt atg gtt tcc cgc tac tgg ttt gaa tcg cta gca ggt 960  
 Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
 305 310 315 320

att ccg tgc gac gtc gaa atc gcc tct gaa ttc cgc tat cgc aaa tct 1008  
 Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
 325 330 335

gcc gtg cgt cgt aac agc ctg atg atc acc ttg tca cag tct ggc gaa 1056  
 Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
 340 345 350

acc gcg gat acc ctg gct ggc ctg cgt ctg tcg aaa gag ctg ggt tac 1104  
 Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
 355 360 365

ctt ggt tca ctg gca atc tgt aac gtt ccg ggt tct tct ctg gtg cgc 1152  
 Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
 370 375 380

gaa tcc gat ctg gcg cta atg acc aac gcg ggt aca gaa atc ggc gtg 1200  
 Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
 385 390 395 400

gca tcc act aaa gca ttc acc act cag tta act gtg ctg ttg atg ctg 1248  
 Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
 405 410 415

gtg gcg aag ctg tct cgc ctg aaa ggt ctg gat gcc tcc att gaa cat	1296		
Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His			
420	425	430	
gac atc gtg cat ggt ctg cag gcg ctg ccg agc cgt att gag cag atg	1344		
Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met			
435	440	445	
ctg tct cag gac aaa cgc att gaa gcg ctg gca gaa gat ttc tct gac	1392		
Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp			
450	455	460	
aaa cat cac gcg ctg ttc ctg agc cgt ggc gat cag tac cca atc gcg	1440		
Lys His His Ala Leu Phe Leu Ser Arg Gly Asp Gln Tyr Pro Ile Ala			
465	470	475	480
ctg gaa ggc gca ttg aag ttg aaa gag atc tct tac att cac gct gaa	1488		
Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu			
485	490	495	
gcc tac gct gct ggc gaa ctg aaa cac ggt ccg ctg gcg cta att gat	1536		
Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp			
500	505	510	
gcc gat atg ccg gtt att gtt gca ccg aac aac gaa ttg ctg gaa	1584		
Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu			
515	520	525	
aaa ctg aaa tcc aac att gaa gaa gtt cgc gcg cgt ggc ggt cag ttg	1632		
Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu			
530	535	540	
tat gtc ttc gcc gat cag gat gcg ggt ttt gta agt agc gat aac atg	1680		
Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met			
545	550	555	560
cac atc atc gag atg ccg cat gtg gaa gag gtg att gca ccg atc ttc	1728		
His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe			
565	570	575	
tac acc gtt ccg ctg cag ctg gct tac cat gtc gcg ctg atc aaa	1776		
Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys			
580	585	590	
ggc acc gac gtt gac cag ccg cgt aac ctg gca aaa tcg gtt acg gtt	1824		
Gly Thr Asp Val Asp Gln Pro Arg Asn Leu Ala Lys Ser Val Thr Val			
595	600	605	

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Glu  
610

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Gly Leu Ala Val Val Asp Ala Glu Gly His Met Thr Arg Leu Arg Arg  
35 40 45

Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
50 55 60

His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80

Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
85 90 95

Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
100 105 110

Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
115 120 125

Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
130 135 140

Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
145 150 155 160

Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
165 170 175

Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
180 185 190

Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
195 200 205

Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
210 215 220

Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
225 230 235 240

Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
245 250 255

Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile  
260 265 270

Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
275 280 285

Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
290 295 300 320

Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
305 310 315

Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
325 330 335

Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
340 345 350

Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
355 360 365

Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg  
370 375 380

Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val  
385 390 395 400

Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
405 410 415

Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
420 425 430

Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met  
435 440 445

Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp  
450 455 460

Lys His His Ala Leu Phe Leu Ser Arg Gly Asp Gln Tyr Pro Ile Ala  
465 470 475 480

Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
485 490 495

Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
500 505 510

Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu  
515 520 525

Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
530 535 540

Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met  
545 550 555 560

His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe  
565 570 575

Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
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Gly Thr Asp Val Asp Gln Pro Arg Asn Leu Ala Lys Ser Val Thr Val  
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<211> 2184

<212> DNA

<213> Escherichia coli

<400> 29

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accatgtgtg gaatttgtgg cgcgatcgcg caacgtgtat tagcagaaat cttcttgaa 180

gtttacgtc gtctggaata ccgcggatat gactctgccg gtctggccgt tttgtatgca 240

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<212> DNA  
<213> Escherichia coli

<220>  
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<222> (1)..(1830)

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ctt ctt gaa ggt tta cgt cgt ctg gaa tac cgc gga tat gac tct gcc 96  
Leu Leu Glu Gly Leu Arg Arg Leu Glu Tyr Arg Gly Tyr Asp Ser Ala  
20 25 30

ggt ctg gcc gtt gtt gat gca gaa ggt cat atg acc cgc ctg cgt cgc 144  
Gly Leu Ala Val Val Asp Ala Glu Gly His Met Thr Arg Leu Arg Arg  
35 40 45

ctc ggt aaa gtc cag atg ctg gca cag gca gcg gaa gaa cat cct ctg 192  
Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
50 55 60

cat ggc ggc act ggt att gct cac act cgc tgg gcg acc cac ggt gaa 240  
His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80

cct tca gaa gtg aat gcg cat ccg cat gtt tct gaa cac att gtg gtg 288  
 Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
       85                  90                  95  
  
 gtg cat aac ggc atc atc gaa aac cat gaa ccg ctg cgt gaa gag cta 336  
 Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
       100              105              110  
  
 aaa gcg cgt ggc tat acc ttc gtt tct gaa acc gac acc gaa gtg att 384  
 Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
       115              120              125  
  
 gcc cat ctg gtg aac tgg gag ctg aaa caa ggc ggg act ctg cgt gag 432  
 Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Thr Leu Arg Glu  
       130              135              140  
  
 gcc gtt ctg cgt gct atc ccg cag ctg cgt ggt gcg tac ggt aca gtg 480  
 Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
       145              150              155              160  
  
 atc atg gac tcc cgt cac ccg gat acc ctg ctg gcg gca cgt tct ggt 528  
 Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
       165              170              175  
  
 agt ccg ctg gtg att ggc ctg ggg atg ggc gaa aac ttt atc gct tct 576  
 Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
       180              185              190  
  
 gac cag ctg gcg ctg ttg ccg gtg acc cgt cgc ttt atc ttc ctt gaa 624  
 Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
       195              200              205  
  
 gag ggc gat att gcg gaa atc act cgc cgt tcg gta aac atc ttc gat 672  
 Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
       210              215              220  
  
 aaa act ggc gcg gaa gta aaa cgt cag gat atc gaa tcc aat ctg caa 720  
 Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
       225              230              235              240  
  
 tat gac gcg ggc gat aaa ggc att tac cgt cac tac atg cag aaa gag 768  
 Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
       245              250              255  
  
 atc tac gaa cag ccg aac gcg atc aaa aac acc ctt acc gga cgc atc 816  
 Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile  
       260              265              270

agc cac ggt cag gtt gat tta agc gag ctg gga ccg aac gcc gac gaa	864		
Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu			
275	280	285	
ctg ctg tcg aag gtt gag cat att cag atc ctc gcc tgc ggt act tct	912		
Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser			
290	295	300	
tat aac tcc ggt atg gtt tcc cgc tac tgg ttt gaa tcg cta gca ggt	960		
Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly			
305	310	315	320
att ccg tgc gac gtc gaa atc gcc tct gaa ttc cgc tat cgc aaa tct	1008		
Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser			
325	330	335	
gcc gtg cgt cgt aac agc ctg atg atc acc ttg tca cag tct ggc gaa	1056		
Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu			
340	345	350	
acc gcg gat acc ctg gct ggc ctg cgt ctg tcg aaa gag ctg ggt tac	1104		
Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr			
355	360	365	
ctt ggt tca ctg gca atc tgt aac gtt ccg ggt tct tct ctg gtg cgc	1152		
Leu Gly Ser Leu Ala Ile Cys Asn Val Pro Gly Ser Ser Leu Val Arg			
370	375	380	
gaa tcc gat ctg gcg cta atg acc aac gcg ggt aca gaa atc ggc gtg	1200		
Glu Ser Asp Leu Ala Leu Met Thr Asn Ala Gly Thr Glu Ile Gly Val			
385	390	395	400
gca tcc act aaa gca ttc acc act cag tta act gtg ctg ttg atg ctg	1248		
Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu			
405	410	415	
gtg gcg aag ctg tct cgc ctg aaa ggt ctg gat gcc tcc att gaa cat	1296		
Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His			
420	425	430	
gac atc gtg cat ggt ctg cag gcg ctg ccg agc cgt att gag cag atg	1344		
Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met			
435	440	445	
ctg tct cag gac aaa cgc att gaa gcg ctg gca gaa gat ttc tct gac	1392		
Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp			
450	455	460	

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Lys His His Ala Leu Phe Leu Ser Arg Gly Asp Gln Tyr Pro Ile Ala  
465 470 475 480

ctg gaa ggc gca ttg aag ttg aaa gag atc tct tac att cac gct gaa 1488  
Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
485 490 495

gcc tac gct gct ggc gaa ctg aaa cac ggt ccg ctg gcg cta att gat 1536  
Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
500 505 510

gcc gat atg ccg gtt att gtt gtt gca ccg aac aac gaa ttg ctg gaa 1584  
Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu  
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Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
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His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe  
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tac acc gtt ccg ctg cag ctg ctg gct tac cat gtc gcg ctg atc aaa 1776  
Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
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ggc acc gac gtt gac cag ccg cgt aac ctg gca aaa tcg gtt acg gtt 1824  
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Glu  
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Gly Leu Ala Val Val Asp Ala Glu Gly His Met Thr Arg Leu Arg Arg  
35 40 45

Leu Gly Lys Val Gln Met Leu Ala Gln Ala Ala Glu Glu His Pro Leu  
50 55 60

His Gly Gly Thr Gly Ile Ala His Thr Arg Trp Ala Thr His Gly Glu  
65 70 75 80

Pro Ser Glu Val Asn Ala His Pro His Val Ser Glu His Ile Val Val  
85 90 95

Val His Asn Gly Ile Ile Glu Asn His Glu Pro Leu Arg Glu Glu Leu  
100 105 110

Lys Ala Arg Gly Tyr Thr Phe Val Ser Glu Thr Asp Thr Glu Val Ile  
115 120 125

Ala His Leu Val Asn Trp Glu Leu Lys Gln Gly Gly Thr Leu Arg Glu  
130 135 140

Ala Val Leu Arg Ala Ile Pro Gln Leu Arg Gly Ala Tyr Gly Thr Val  
145 150 155 160

Ile Met Asp Ser Arg His Pro Asp Thr Leu Leu Ala Ala Arg Ser Gly  
165 170 175

Ser Pro Leu Val Ile Gly Leu Gly Met Gly Glu Asn Phe Ile Ala Ser  
180 185 190

Asp Gln Leu Ala Leu Leu Pro Val Thr Arg Arg Phe Ile Phe Leu Glu  
195 200 205

Glu Gly Asp Ile Ala Glu Ile Thr Arg Arg Ser Val Asn Ile Phe Asp  
210 215 220

Lys Thr Gly Ala Glu Val Lys Arg Gln Asp Ile Glu Ser Asn Leu Gln  
225 230 235 240

Tyr Asp Ala Gly Asp Lys Gly Ile Tyr Arg His Tyr Met Gln Lys Glu  
245 250 255

Ile Tyr Glu Gln Pro Asn Ala Ile Lys Asn Thr Leu Thr Gly Arg Ile

260 265 270  
Ser His Gly Gln Val Asp Leu Ser Glu Leu Gly Pro Asn Ala Asp Glu  
275 280 285  
Leu Leu Ser Lys Val Glu His Ile Gln Ile Leu Ala Cys Gly Thr Ser  
290 295 300  
Tyr Asn Ser Gly Met Val Ser Arg Tyr Trp Phe Glu Ser Leu Ala Gly  
305 310 315 320  
Ile Pro Cys Asp Val Glu Ile Ala Ser Glu Phe Arg Tyr Arg Lys Ser  
325 330 335  
Ala Val Arg Arg Asn Ser Leu Met Ile Thr Leu Ser Gln Ser Gly Glu  
340 345 350  
Thr Ala Asp Thr Leu Ala Gly Leu Arg Leu Ser Lys Glu Leu Gly Tyr  
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385 390 395 400  
Ala Ser Thr Lys Ala Phe Thr Thr Gln Leu Thr Val Leu Leu Met Leu  
405 410 415  
Val Ala Lys Leu Ser Arg Leu Lys Gly Leu Asp Ala Ser Ile Glu His  
420 425 430  
Asp Ile Val His Gly Leu Gln Ala Leu Pro Ser Arg Ile Glu Gln Met  
435 440 445  
Leu Ser Gln Asp Lys Arg Ile Glu Ala Leu Ala Glu Asp Phe Ser Asp  
450 455 460  
Lys His His Ala Leu Phe Leu Ser Arg Gly Asp Gln Tyr Pro Ile Ala  
465 470 475 480  
Leu Glu Gly Ala Leu Lys Leu Lys Glu Ile Ser Tyr Ile His Ala Glu  
485 490 495  
Ala Tyr Ala Ala Gly Glu Leu Lys His Gly Pro Leu Ala Leu Ile Asp  
500 505 510  
Ala Asp Met Pro Val Ile Val Val Ala Pro Asn Asn Glu Leu Leu Glu

515

520

525

Lys Leu Lys Ser Asn Ile Glu Glu Val Arg Ala Arg Gly Gly Gln Leu  
530 535 540

Tyr Val Phe Ala Asp Gln Asp Ala Gly Phe Val Ser Ser Asp Asn Met  
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His Ile Ile Glu Met Pro His Val Glu Glu Val Ile Ala Pro Ile Phe  
565 570 575

Tyr Thr Val Pro Leu Gln Leu Leu Ala Tyr His Val Ala Leu Ile Lys  
580 585 590

Gly Thr Asp Val Asp Gln Pro Arg Asn Leu Ala Lys Ser Val Thr Val  
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Glu

3.0024460 3.24204